Brief Communication

Iatrogenic Injury to the Long Thoracic Nerve

An Underestimated Cause of Morbidity after Cardiac Surgery

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After heart surgery, complications affecting the brachial plexus have been reported in 2% to 38% of cases. The long thoracic nerve is vulnerable to damage at various levels, due to its long and superficial course. This nerve supplies the serratus anterior muscle, which has an important role in the abduction and elevation of the superior limb; paralysis of the serratus anterior causes "winged scapula," a condition in which the arm cannot be lifted higher than 90° from the side. Unfortunately, the long thoracic nerve can be damaged by a wide variety of traumatic and nontraumatic occurrences, ranging from viral or nonviral disease to improper surgical technique, to the position of the patient during transfer to a hospital bed.

Our patient, a 62-year-old man with triple-vessel disease, underwent myocardial revascularization in which right and left internal thoracic arteries and the left radial artery were grafted to the right coronary, descending anterior, and obtuse marginal arteries, respectively. Despite strong recovery and an apparently good postoperative course, the patient sued for damages due to subsequent winging of the left scapula.

In this instance, the legal case has less to do with the cause of the lesion (which remains unclear) than with failure to adequately inform the patient of possible complications at the expense of the nervous system. The lesson is that each patient must receive detailed written and oral explanation of the potential benefits and all conceivable risks of a procedure. ***(Tex Heart Inst J 2001;28:315-7)***

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Although mortality in association with heart surgery has been dramatically reduced for large groups of patients, the reduction of morbidity remains a primary objective in patient management. All of the innovative minimally invasive surgical techniques have the aim of reducing morbidity, in accordance with the principle that the physical integrity of the patient should be disturbed as little as possible. Despite this, complications still occur, and these are often underestimated or disregarded.

After heart surgery in general, it is not infrequent to encounter damage to the structure of the nervous system. In a highly variable percentage of cases, the brachial plexus is the recipient of that injury. The long thoracic nerve is a branch of the supraclavicular portion of the brachial plexus that supplies the serratus anterior muscle with nerves. Lesions of this nerve are apparently not as frequent as those of other nerves arising from the plexus, but the incidence of damage might well be underestimated. As a consequence of a medical liability action, we decided to publish this report of a lesion of the long thoracic nerve in a patient who had undergone coronary artery bypass grafting with arterial conduits alone.

Case Report

In September of 1997, a 62-year-old man presented with a 3-month history of unstable angina. His risk factors for coronary disease were hypertension and a history of smoking. Exercise stress testing elicited angina and markedly abnormal ST segments. Cardiac catheterization showed triple-vessel disease. The patient was scheduled for coronary artery bypass grafting.

During the operation, he was placed on cardiopulmonary bypass and cardioplegia was induced with antegrade and retrograde infusion of cold blood. Both the right and left internal thoracic arteries and the left radial artery were dissected and anastomosed to the right coronary, descending anterior, and obtuse marginal arter-

ies, respectively. Harvesting the internal thoracic arteries was accomplished with the aid of a Favaloro retractor. The patient was weaned easily from bypass and exhibited excellent cardiac function. His postoperative course was apparently uncomplicated, so discharge to another hospital closer to the patient's home was allowed on the 4th postoperative day.

Two months later, the patient's attorneys presented our hospital with a request for damages, due to the postoperative onset of "winging" of the left scapula, caused by paresis (35% loss of use) of the serratus anterior muscle. Thereby a legal proceeding started and is still in progress.

Discussion

The long thoracic nerve is purely a motor nerve, which originates from the anterior branches of the 5th, 6th, and 7th cervical roots. It supplies the serratus anterior muscle.[1] The 5th and 6th roots, along with the dorsal nerve of the scapula, pass across the fibers of the scalenus medius muscle to reach the long thoracic nerve, while the 7th cervical root passes anteriorly to make the connection. The nerve thus runs from behind the clavicle to reach the 1st rib, and from there it descends along the lateral wall of the thorax down to the 8th and 9th ribs to supply the serratus anterior muscle with nerves. The nerve's long and superficial course makes it susceptible to damage at various levels. For example, the superior region and the lateral thoracic wall can sustain neurologic damage as a consequence of insufficient traction upon the superior limb, as in cases of extreme abduction during general anesthesia. In fact, the serratus anterior is a large muscle that arises from the external surfaces of the first 8 ribs and attaches to the costal surface of the scapula. It has an important role in the abduction and elevation of the superior limb and can act as an accessory muscle in lifting the ribs during inspiration. The paralysis of this muscle causes "winged scapula": in this condition, the surface of the scapula moves away from the thoracic wall, the shoulder falls downward, and the arm can no longer be lifted higher than 90º when it is stretched out sideways.

In general, damage to the long thoracic nerve is caused by both traumatic and nontraumatic events. In 26% of cases, it involves closed trauma of the thorax or the scapular girdle, such as occurs during falls or collisions.[2] Sporting activities account for 35% of damaging events:[3] volleyball, weightlifting, and archery, for example, can subject the shoulder to an abduction so exaggerated that the inferior corner of the bone compresses or stretches the nerve. Penetrative trauma can directly damage the nerve during, for example, radical mastectomy with lymph node removal, resection of the 1st rib, transaxillary sympathectomy, cannulation of the internal jugular vein, axillary cannulation, and minimal thoracotomies for thoracic drainage. It can also occur during or after minimally invasive port-access mitral valve surgery,[4,5] in which case the iatrogenic damage to the side is responsible for 11% of paralyses of the serratus anterior muscle[6] and can be linked to the position of the patient either on the operating table or during transfer to another bed. Even nontraumatic causes can paralyze this nerve: viral and nonviral diseases (such as parvovirus, leprosy, diphtheria, tetanus, and poliomyelitis), immunizations, vitamin deficiency diseases, metabolic disorders, toxins, Parsonage-Turner syndrome,[7-9] and isolated neurites can all cause damage, as well as compressions at the site of the 7th cervical root. In 17% of patients, the damage is idiopathic.[10]

After heart surgery, complications affecting the brachial plexus nervous system are not infrequent, having been reported in 2% to 38% of cases.[11] Most commonly involved are the inferior nerve roots, the medial cord, and the ulnar branch, usually on the left side, and usually in male patients who have undergone removal of the internal thoracic artery. From a theoretical point of view, all of the nerves belonging to the brachial plexus are susceptible to iatrogenic damage, the pathogenesis of which has been attributed to numerous factors, few of which are certain or well defined. The points under discussion in the literature have been the position of the patient on the operating table, the position of the superior limbs or of the head and neck, and (with less confidence) the use of interscapular coils. As mentioned above, catheterization of the internal jugular vein can sever a nerve, most likely one of the superior structures.[12]

According to some authors, improper techniques of incision and sternal retraction are important causes of damage during heart surgery. In fact, the nerve roots are anchored to their points of exit from the vertebral canal and extend to attachment points on the axillary sheet. Every mechanical action that increases the distance between these 2 attachment points can stretch the roots themselves; the same technique in the preparation of the internal thoracic peduncle can damage the roots indirectly by exerting asymmetrical traction on the sternal margin, both stretching the plexus and compressing it between the clavicle and the 1st rib. High sternal fractures and bruising of the 1st rib can exert compressive, and therefore ischemic, effects on the nerve roots and even on the sympathetic nerve chain, the consequence of which is Horner's syndrome.[13]

In our patient, almost any of the perioperative events described above could have damaged the long thoracic nerve. Removal of the radial artery could have been accompanied by excessive abduction of the superior limb, with the consequential compression of

nervous structures by the scapula. Yet the cause could be any maneuver that is carried out in a hospital, from transporting the patient to the operating theater to transferring him from 1 bed to another.

This case report raises the matter of informed consent: the legal case has less to do with the lesion that caused the winged scapula than it does with failure to adequately inform the patient of the possibility of complications at the expense of the nervous system. The lesson to be learned is that each patient or his representative must receive detailed written and oral explanation of potential benefits and all conceivable risks of a procedure. Once opened, the door of informed consent cannot be closed part way.

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